

Chapter 1 Introduction

1-1. Purpose

This Engineer Manual provides guidance to Corps of Engineers (CE) personnel who are responsible for groundwater-related projects. This manual was written with special attention to groundwater-related applications prevalent within the CE. Thus, sections addressing site investigation procedures and the performance of modeling studies are included. Additionally, a chapter focusing on the interaction between surface water and groundwater is included.

1-2. Applicability

This manual applies to all USACE Commands having civil works responsibilities. This manual provides information for application to common Corps groundwater-related studies, including:

- a.* Site characterization for contaminant remediation.
- b.* Computer modeling of groundwater flow.
- c.* Groundwater and surface water interaction studies.
- d.* Reservoir operations.
- e.* Groundwater flow to adjacent locks and dams.
- f.* Remediation of reservoir leakage.
- g.* Infiltration of runoff to the subsurface.
- h.* Baseflow between aquifers and fixed bodies including streams and reservoirs.
- i.* Effects of aquifer pumping on adjacent lakes and streams.
- j.* Well installation involved with seawater infiltration barriers.
- k.* Dewatering of an excavation for construction purposes.

- l.* General regional and local applications.

1-3. References

A variety of sources were used to compile the information presented herein. This includes publications of professional societies, and guidance developed by the Corps of Engineers and other federal agencies. Appendix A contains a complete list of references. The following texts provide a general understanding of groundwater concepts and principles.

- a.* Driscoll, F. G. 1986. "Groundwater and Wells," 2nd ed., Johnson Wheelabrator Water Technologies, Inc., St. Paul, MN.
- b.* Domenico, P. A., and Schwartz, F. W. 1990. "Physical and chemical hydrogeology," John Wiley and Sons, NY.
- c.* Fetter, C. W. 1994. "Applied hydrogeology," 3rd ed., Charles E. Merrill Pub., Columbus, OH.
- d.* Freeze, R. A., and Cherry, J. A. 1979. "Groundwater," Prentice-Hall, Inc., Englewood Cliffs, NJ.
- e.* U.S. Department of the Interior. 1977. "Ground water manual - A water resources technical publication," U.S. Department of the Interior, Bureau of Reclamation.
- f.* Heath, Ralph C. 1987. "Basic ground-water hydrology," U.S. Geological Survey *Water-Supply Paper* 2220.

1-4. Distribution Statement

Approved for public release; distribution is unlimited.

1-5. Focus

This manual focuses on areas of particular concern to Corps projects. In the past 10 years, significant technical progress has been made in the field of computer modeling of groundwater flow. These new modeling technologies have had widespread applications within the Corps. This manual provides

specific information regarding the performance of a site investigation and conducting a modeling study. Additionally, a significant portion of Corps applications are involved with surface water. The interrelationship of surface water and groundwater should be considered on all Corps surface water and applicable groundwater projects. This manual addresses analytical and numerical methods for quantifying the water exchange between surface water and groundwater.

1-6. Approach

This manual is intended for the use by Corps personnel in planning and designing groundwater-related projects. In many field applications, it is not possible to provide specific instructions and/or specific procedures that are universally applicable to every situation that may be encountered. Therefore, this manual emphasizes the use of sound judgement and the development of a good understanding of basic groundwater concepts rather than providing specific guidelines.

1-7. Scope

The manual provides a general overview of groundwater principles. Practical discussions are provided for planning groundwater investigations and modeling of groundwater flow. Additionally, a section on surface water and groundwater interaction is included. To enhance understanding of concepts, examples are provided throughout the document.

1-8. Format

This manual initially presents an overview of the occurrence and movement of groundwater. Procedures for planning and managing a site characterization and modeling study are then presented. This is followed by chapters addressing the technical aspects of field investigative methods and computer modeling. A final chapter discussing the interaction of groundwater and surface water is then presented. Appendices are included that contain detailed references, definitions, and additional supporting information.

a. Chapter 2. "Occurrence and Movement of Groundwater," presents an overview of general concepts. For Corps-specific applications, a section on estimating the capture zones of pumping wells is included.

b. Chapter 3. "Planning a Groundwater Investigation and Modeling Study," provides general guidelines for performing a site characterization, and integrating hydrogeologic information into a computer model. This includes: initial site reconnaissance, data interpretation, acquisition of additional data, conceptual model formulation, and general steps in developing a groundwater flow model. Additionally, project management guidelines are included.

c. Chapter 4. "Field Investigative Methods." Adequate conceptualization of a hydrogeologic system often requires the acquisition of new field data. This chapter provides an overview of different methods that can be employed to gain a better understanding of subsurface conditions. Key references are provided to allow for a more detailed understanding of concepts and applications.

d. Chapter 5. "Computer Modeling of Groundwater Flow," presents a technical overview of numerical modeling of groundwater flow.

e. Many Corps projects are related to the interaction of groundwater and surface water. Chapter 6, "Interaction Between Surface Water and Groundwater," provides an overview of the distribution and movement of water in the subsurface. Practical analytical methods which quantify the interaction between surface water and groundwater are presented. Numerical models are often employed to quantify the water exchange between the surface and subsurface. This chapter presents an overview of current technology available for the simulation of interaction between surface water and groundwater. Key references are provided to allow for a more detailed understanding of concepts and applications.